

Dextromethorphan recreational use and poisoning – the social and psychological background

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A – Study Design, **B** – Data Collection, **C** – Statistical Analysis, **D** – Data Interpretation, **E** – Manuscript Preparation, **F** – Literature Search, **G** – Funds Collection

Summary Background. Dextromethorphan (DXM) is a widely used over-the-counter antitussive drug. In supratherapeutic doses, it exerts psychoactive effects. Use of DXM seems very common among people seeking ‘illegal or legal highs’.

Objectives. The aim of the study is to assess the social and psychological features of DXM users.

Material and methods. Data on DXM poisoning ($n = 103$; adults and youths) in Lodz Province from January 2011 to March 2015 were obtained. Furthermore, analyses of the psychological or psychiatric examination of patients were performed. The symptoms of acute intoxication and ingested doses were reported to evaluate the course and possible tolerance.

Results. Recreational DXM poisoning was the main reason for the admission of the majority of patients (53%). This phenomenon was observed mainly in the group of adolescents and young adults. The average dose ranged from 5 up to 120 pills of 15 mg each. Co-administration with alcohol was reported in 45% of patients. Clinical presentation included predominantly balance disorders, psychomotor retardation and agitation. There was a difference in psychosocial risk factors between genders: living alone and relationship problems were significantly more frequent in females.

Conclusions. Our study highlights gender differences in psychosocial risk factors for DXM use, a potential role of the family environment, substance addiction, and organic diseases in the development of DXM dependence.

Key words: substance addiction, dextromethorphan, poisoning, recreational drugs.

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Background

Dextromethorphan (DXM) is a widely used over-the-counter substance (OTC) in Poland, available in simple antitussive drugs and in complex anti-cold preparations [1, 2].

In therapeutic doses, the drug is safe. In supratherapeutic doses, the substance exerts psychoactive (dissociative and euphoric) effects. As an N-methyl-D-aspartate (NMDA) antagonist, DXM in high concentrations shows dissociative properties, similar to the effects of phencyclidine or ketamine [3].

DXM use is very common among young people who are seeking recreational ‘illegal or legal highs’. What is more, owing to easy availability, hallucinogenic effects and euphoric high at larger doses, the popularity of DXM amongst drug abusers is growing day by day. Recreational usage information is readily available in social media and anonymous forums, which enables youngsters to extract the ‘advice’ they need to buy and properly administer the drug [4]. Depending on the dose ingested and weight of the individual, the symptoms and subjective psychoactive effect might vary – from mild deepening of sensual perception to hallucinations, dream-like visions and out-of-body experience [4, 5]. In spite of high exposure, drug poisonings and fatal abuse are relatively rare [6, 7].

DXM also causes psychological addiction [7]. Drug abusers also mix DXM with alcohol, cannabinoids, opiates, benzodiazepines and other drugs to obtain even stronger but dangerous effects (despite lethal synergistic effects) [7]. According to literature data, the therapeutic blood level of DXM ranges from 0.005 to 0.06 mg/L. The lethal blood concentration of DXM ranges from 3.3 to 9.5 mg/L and 31–230 mg/kg in the liver [4, 7].

It is worth considering the presumptive factors that are associated with drug poisoning. Due to DXM’s recreational effects, DXM and alcohol addicts constitute a high-risk group. Also, patients with psychological or psychiatric problems abuse the substance because of its calming, euphoric or ‘escaping’ effects. Additionally, patients attempting suicide frequently abuse readily available, random OTC drugs. Family practitioners should remember that the growing popularity of DXM may lead to the increased frequency of acute poisonings and psychological addictions [2, 7, 8]. Patients registered due to admissions to emergency care because of severe side effects presumably represent merely ‘the tip of the iceberg’. Thus, the repeated use of antitussive drugs by patients – especially adolescents – should be regarded with proper attention by general practitioners, as well as by patients’ families and tutors. However, it seems that many doctors and parents are still unaware of the clinical presentation of DXM abuse and its deceitful nature.



Objectives

The aim of the study is to assess the social and psychological features of DXM users and to identify the causes, dosage of the drug, and symptoms in patients abusing DXM. The symptoms of acute intoxication and ingested doses have been reported to evaluate the course and possible tolerance.

Material and methods

Study design and setting

A retrospective study was conducted at the Department of Toxicology of the Nofer Institute of Occupational Medicine.

Participants

We analyzed 103 cases of patients from Lodz Province hospitalized for DXM poisoning from 1st January 2011 to 1st March 2015. Confirmation of the intake of DXM was obtained directly from the patient or witnesses.

Variables and data sources

The study involved patients who were diagnosed with a condition resulting from misuse of DXM: acute poisoning – diagnosis code T 48.3 in the International Classification of Diseases and Related Health Problems ICD-10 [9].

Clinical examinations, patient histories and medical records allowed information concerning personal data, history of recreational use, current symptoms and substance dependency history to be obtained, leading to an outline of the socio-psychological profiles of patients. Treatment and outcomes were also analyzed.

Furthermore, the analysis of the psychological or psychiatric examination of patients was performed.

The patients selected for psychiatric consultation included those with psychotic abnormalities in DXM poisoning, those who had declared a willingness to receive such consultation, and those with a past history of psychiatric diseases.

Analyses

All the patients had their urine checked in order to detect DXM by thin layer chromatography. The urinary test package also included testing for the most popular drugs (tetrahydrocannabinol [THC], amphetamines, opiates) by enzyme immunoassay using a VIVA analyzer from Siemens. In addition, in all patients, atropine and ephedrine were determined qualitatively in urine by thin layer chromatography. Each patient was routinely subjected to quantitative determination of the ethanol concentration in blood by gas chromatography (using SRI 310C apparatus). The study was approved by the local Bioethics Committee (Protocol No. RNN/349/14/KB).

Statistical methods

Statistical analysis was done using SPSS and Excel 2013. In statistical analysis we used Pearson's correlation; independent sample *t*-test with Cochran–Cox adjustment; Fisher's exact test.

Results

Participants and descriptive data

The group of 103 patients comprised 59 males and 44 females aged from 15 to 48 years. Characteristics of patients admitted to the toxicology department due to DXM poisoning are presented in table 1.

Main results

Our analysis revealed that the largest group of patients consisted of young adolescents, aged 16–25, using the drug for recreation.

The main causes of DXM ingestion were classified as recreational use in 55 patients (53.4%) and suicide attempt in 36 (35%). It is worth noting that some patients reported multiple motives for DXM use. Other reasons were: personal problems in 35 (34%), problems at work/school in 4 (3.9%), curiosity in 5 (4.9%), accidental administration in 3 (2.9%), and unknown reason in 3 (2.9%). Among these, it seems interesting to record unusual reasons: a patient with bulimia abusing DXM for 2 years to avoid eating, and a patient who took 90 pills (1350 mg) with alcohol in order to return to a psychiatric ward (demonstrative attempt).

Medical reports revealed the use of the substance along with alcohol (46 patients – 44.7%), or with drugs (37 patients – 35.9%). Among them, 16 patients (15.5%) took DXM both with drugs and alcohol. In 19 cases, patients simultaneously took several drugs. Some of the ingested substances were illegal (such as amphetamine, cocaine, opiates) or on prescription (e.g. ephedrine, atropine, antipsychotic or hypotensive drugs). In addition, some of the drugs had recreational properties (e.g. benzydamine, 'legal highs', codeine, above-listed illegal drugs). However, it should be noted that many of them were random and unknown, especially those used in suicide attempts. Poisoning with DXM only was registered in 36 patients.

We collected exact data about the number of pills ingested by 85 out of 103 admitted patients. The range of doses taken was wide – from 5 to as many as 180 pills of 15 mg each (75 mg to 2700 mg) DXM (Figure 1).

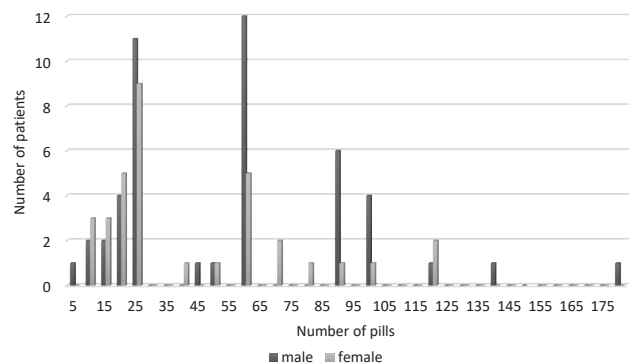


Figure 1. Doses of the drugs ingested depending on gender

Statistical analysis revealed that there was neither a correlation between the number of pills ingested and age (Pearson's correlation; $p = 0.304$; $\alpha = 0.05$), nor between the number of pills and gender (independent sample *t*-test with Cochran–Cox adjustment; $p = 0.067$; $\alpha = 0.05$). On admission, 33 patients (32%) were in good condition, and 66 patients (64.1%) were in moderate condition (Table 1).

Four patients presented severe outcomes; 3 of them ingested a high amount of the drug (at least 100 = 1500 mg), one after intake of DXM along with acetaminophen and dimenhydrinate. Physical examinations revealed many abnormalities – the most common were balance disorders (94 patients) and alterations in mental status: psychomotor retardation (48), agitation (18), hallucinations (9) (Table 2). Somatic complaints were mainly neurological (balance disorders, nystagmus ($n = 94\%$), cardiovascular (tachycardia/bradycardia, heart palpitations) ($n = 65\%$) and gastrointestinal (nausea, vomiting, abdominal pain) effects ($n = 12\%$).

On admission, the average heart rate was 101/min (max 150/min, min 50/min), and arterial blood pressure values were as follows: systolic mean 132 mm Hg (max 187 mm Hg, min 90 mm Hg); diastolic mean 83 mm Hg, (max 110 mm Hg, min 40 mm Hg).

Table 1. Characteristics of patients admitted to the toxicology department due to DXM poisoning

	Recreational use <i>n</i> = 55 (53.4%)	Suicide attempts <i>n</i> = 36 (35%)	Other reasons <i>n</i> = 12 (11.6%)	All <i>n</i> = 103 (100%)
General characteristics				
Gender (male/female)	40/15	13/23	6/6	59/44
Range of ingested dose of DXM [mg]*	75–2250 (5–150 pills)	180–2700 (12–180 pills)	150–1350 (10–90 pills)	75–2700 (5–180 pills)
Coadministration with alcohol	24 (43.6%)	17 (47.2%)	4 (33.3%)	46 (44.7%)
Coadministration with recreational drugs	15/10 (27.3%/18.2%)	20/4 (55.6%/11.1%)	2/0 (17%)	37/16 (35.9%/15.5%)
Coadministration with alcohol and drugs	5 (9.1%)	9 (25%)	1 (8%)	16 (15.5%)
Range of blood alcohol concentration [mg%]	0–395	0–245	0–160	0–395
Time of hospitalization [days]	2.09	2.31	1.92	2.16
Discharge from hospital				
– transfer to the psychiatric ward	13 (23.6%)	25 (69.4%)	5 (41.7%)	41 (39.8%)
– treatment finishing	18 (32.7%)	5 (13.8%)	3 (25%)	37 (35.9%)
– discharge on demand	24 (43.6%)	6 (16.7%)	4 (33.3%)	35 (34%)
DXM use: first time/ repeatedly/no information	6/41/8	3/16/17	1/5/6	10/60/33
Physiological responses				
Consciousness/unconsciousness at admission	55/0	34/2	12/0	101/2
Medical state at admission: good/moderate/serious	20/33/2	8/26/2	4/8	33/66/4
tachycardia/bradycardia	21/2	15/1	7/0	42/3
hyper-/hypotension	20/1	17/1	5/0	32/3
iris: mydriasis/n.a./miosis**	17/36/2	8/25/3	4/7/1	28/68/7

* In cases of precisely reported doses, ** n.a. – no abnormalities.

Table 2. Abnormalities in the physical examination in DXM poisonings at the time of admission (Fisher's exact test; $\alpha = 0.05$)

	Recreational use <i>n</i> = 55 (53.4%)	Suicide attempts <i>n</i> = 36 (35%)	<i>p</i>
Psychomotor retardation	23 (41.8%)	19 (52.8%)	0.390
Agitation	11 (20%)	5 (13.9%)	0.577
Hallucinations	5 (9.1%)	3 (8.3%)	1.000
Balance disorders	53 (96.4%)	30 (83.3%)	0.054
Vertigo	8 (14.5%)	2 (5.6%)	0.130
Nystagmus	5 (9.1%)	9 (25%)	0.072
Seizures	3 (5.5%)	3 (8.3%)	0.678

Table 3. Social and psychological risk factors in patients admitted due to DXM poisoning (Fisher's exact test; $\alpha = 0.05$)

	Recreational use <i>n</i> = 55 (53.4%)	Suicide attempts <i>n</i> = 36 (35%)	<i>p</i>
Recreational drug dependence	36 (65.5%)	10 (27.8%)	0.001
Multiple drug and alcohol dependence	13 (23.6%)	3 (8.3%)	0.09
History of hospitalization in toxicological ward	24 (43.6%)	5 (13.9%)	0.003
History of hospitalization in psychiatric ward	24 (43.6%)	12 (33.3%)	0.384

Additionally, the medical history revealed that 15 patients suffered from chronic somatic diseases (such as dermatitis, diabetes mellitus, epilepsy, hypertension, hypothyroidism) and 35 patients from psychiatric disorders (such as bipolar disorder, depression, personality disorders, schizophrenia), or both somatic and psychiatric disorders (4 patients). It should also be emphasized that the patient history indicated psychosocial risk factors (Table 3).

Moreover, in the group consulted by a psychiatrist or psychologist (52 patients, constituting 50.5% of admissions) many underlying social (unemployment, financial troubles, lack of support from the family) and/or psychological (peer harassment, relationship issues, personality disorders and psychiatric diseases) problems were revealed. Statistically, living alone and relationship problems were the only risk factors more frequent among women (Table 4).

Table 4. Social and psychological risk factors in females and males consulted by a psychologist/psychiatrist (chi-square test/ Yates' chi-squared test; $\alpha = 0.05$)

	Female <i>n</i> = 25 (48.1%)	Male <i>n</i> = 27 (51.9%)	All consulted <i>n</i> = 52 (100%)	<i>p</i>
Sociological problems				
Unemployment	2 (8%)	7 (25.9%)	9 (17.3%)	0.180
Financial troubles	1 (4%)	2 (7.4%)	3 (5.8%)	0.945
Alcohol addiction	5 (20%)	8 (29.6%)	13(25%)	0.423
Psychoactive drug addiction	8 (32%)	11 (40.7%)	19 (36.5%)	0.513
Living alone	19 (76%)	12 (44.4%)	31 (60%)	0.020
Psychological problems				
Mental disorders	8 (32%)	8 (29.6%)	16 (30.8%)	0.853
Family problems	4 (16%)	6 (22.2%)	10 (19.3%)	0.828
Relationship problems	11 (44%)	4 (14.8%)	15 (28.8%)	0.020

Average time of hospitalization was 2.16 days (from 1 to 5 days). During the hospitalization no case of withdrawal syndrome due to DXM was observed. All patients recovered completely.

Discussion

The effects of DXM on the human organism have already been studied. Ressig et al. [6] reported that the substance leads to an increase in blood pressure and heart rate, but also to emesis. Importantly, participants experienced the hallucinogenic effects of the drug, as well as stimulation and somatic effects: tingling and headache [8]. Also, some patients presented psychological symptoms and psychotic manifestations after DXM use – euphoria, increased perceptual awareness, altered time perception, feelings of floating ('sea legs'), tactile, visual or auditory hallucinations, paranoia, dissociative phenomena, mania and psychoses [10]. The aforementioned effects are comparable to the outcomes of our study.

In our opinion, symptoms provoked by high doses of the substance taken by chronic abusers were milder than in patients who took it for the first time. The development of tolerance to the drug has already been described in the literature [11].

Also, it is worth asking the question about possible cross-tolerance in alcohol or drug abusers. The study of Soyka et al. [12] suggested that low doses of DXM may induce an ethanol-like subjective effect and a 'mild craving' for alcohol in alcoholics. Several authors have stressed that even though DXM is not an addictive drug, it might be abused by patients who are, e.g. heroin-, morphine- or opiate-dependent due to the potential of decreasing dependency on them and potentiating their effects [13].

Murray and Brewerton suggest that the drug produces psychological, but not physical, substance dependence syndrome [14]. For example, Miller reported the admission of a female patient ingesting DXM at very high doses, reaching up to 3600 mg a day. In her case, every attempt at minimizing the dose failed due to tolerance, pleasurable euphoric effects, the feeling of empathy, and social relaxation [11].

One Polish study revealed that the older the patients were, the higher the dosage of the drug, generally ranging from 150 to 2700 mg, with a mean dosage of 589 mg [3].

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Although mono- or bipolar disease was diagnosed by psychiatrists only in 5 patients, we might suspect that the majority of them were suffering from mild depressive disorders. This group, especially along with a positive family history of alcoholism and the individual's susceptibility features, is particularly susceptible to DXM's antidepressant activity [15].

Some authors also support the pivotal role of socio-psychological factors as the strongest link to recreational drug use [16]. The significant gender differences highlighted in our research constituted a significant risk factor for DXM use.

Limitations of the study

Limitations of the present study are associated with:

- 1) different times of admission to the hospital after intoxication;
- 2) limited knowledge about precise doses and drugs taken, and pursuant to point 2, it was not possible to assess the dose per kilogram of body weight and thus determine the patient's 'recreational plateau'.

Strengths and importance of the study

We believe that family practitioners need to be aware of DXM's toxicity. We hope that the present paper may represent a useful contribution in this respect.

Conclusions

Summing up, our study highlights gender differences in psychosocial risk factors for DXM use, the potential role of the family environment, substance addiction and organic diseases in the development of DXM dependence. Due to its easy availability for consumption, family practitioners should carefully evaluate each history of drug abuse, and perhaps more often recommend therapeutic (psychological/psychiatric) care for patients seeking DXM's recreational effects. Future studies should not only analyze national trends of DXM abuse, but should also get insight into the particular products involved and the most common age groups abusing them.

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